

THE YANGBAJING GEOTHERMAL FIELD, TIBET: HEAT SOURCE AND FLUID FLOW

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PROJECT OBJECTIVES

The chemical characterization of fluids in a geothermal reservoir is essential for realizing optimum utilization of the resource. The isotopic composition of elements in fluids provides a quantitative measure of material balance, and therefore isotopes are extremely powerful in unraveling fluid histories and tracing fluid flow. In this regard, conservative elements, such as the noble gases (He, Ne, Ar, Kr, and Xe), are extremely useful because they preserve isotopic information related to initial conditions and sources.

APPROACH

The isotopes of the inert noble gases provide long-lasting tracers of fluid sources, such as large ³He enrichments in deep fluids originating in the mantle and enrichments in radiogenic ⁴He and ⁴⁰Ar in crustal fluids. The occurrence and mixing of these various components provide tools for identifying specific fluid sources, fluid flow paths from source to reservoir, and geothermal-reservoir characteristics as defined by mixing, fluid residence times, and chemical processes.

ACCOMPLISHMENTS

The Yangbajing geothermal field, located ~94 km northwest of Lhasa, Tibet, has an installed capacity of ~25 MWe. Production is from liquid-dominated, shallow, moderate-temperature (150–165°C) reservoirs. However, Na/K geothermometer temperatures and recent drilling in the NW sector of the field indicate the presence of a deeper, higher-temperature (~300°C) reservoir beneath the shallow reservoir.

The ³He/⁴He ratios in fluids from the Yangbajing Field were found to be low (0.26 Ra) relative to typical mantle values (8–9 Ra). Despite the discovery of the high-temperature deeper reservoir, a deep resistivity anomaly inferred to be a magma body, and long-held conceptual models for the Yangbajing Field calling on a magmatic heat source, the helium isotopic compositions suggests very little (if any) involvement of recently intruded magmas. If the heat source is a magma body, then the helium has been extensively diluted with radiogenic ⁴He by

water-rock interaction or roof foundering in the magma chamber. Alternatively, the helium isotopes may suggest that heat is mined not from a magmatic intrusion but by deep circulation of meteoric waters along the Yarlu-Zangbo suture. Variations in helium abundance and isotopic composition are consistent with the mixing of a deep-high ³He/⁴He fluid (~0.26 Ra) with the shallower overlying reservoir (<0.09 Ra) currently being produced.

SIGNIFICANCE OF FINDINGS

The helium isotopic composition of the Yangbajing geothermal fluids is inconsistent with a strong magmatic influence. In light of the helium isotopic data, the inferred significance of the resistivity anomaly should be reconsidered. Variations in helium abundance and isotopic composition support mixing between the deep and shallow reservoirs, suggesting that extensive exploitation of the deeper fluids could accelerate depletion of the shallow resource.

RELATED PUBLICATIONS

Zhao, P., B.M. Kennedy, D. Shuster, J. Dor, E. Xie, and S. Du, Implications of noble gas geochemistry in the Yangbajing geothermal field, Tibet, Proc. 10th Water-Rock Conference, 2, pp. 947–950, Villasimus, Italy, July 10–15, 2001.

Zhao, P., J. Dor, and J. Jin, A new geochemical model of the Yangbajing geothermal field, Tibet, Proc. World Geothermal Congress, Kyushu-Tohoku, Japan, pp. 2007–2012, May 28–June 10, 2000.

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